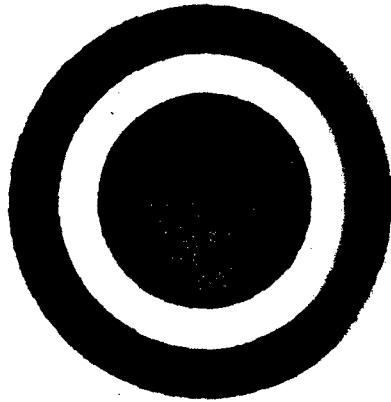


PREFINAL REPORT-AUGUST 1986
VOLUME 1-Executive Summary



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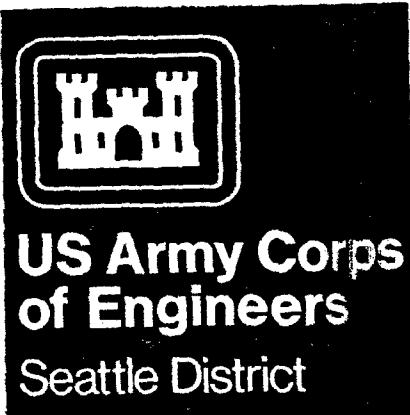
**FORT LEWIS
ENERGY SAVINGS
OPPORTUNITY SURVEY**

19971021 303

**ENERGY ENGINEERING
ANALYSIS PROGRAM
(EEAP)
AT
FT. LEWIS, WASHINGTON
(A FORSCOM INSTALLATION)**

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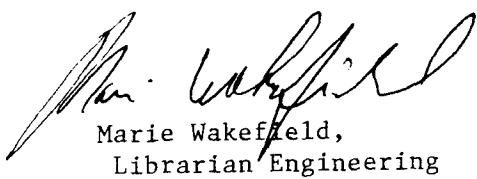
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FORT LEWIS ESOS
PREFINAL REPORT
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1.0 EXECUTIVE SUMMARY

1.1 PURPOSE OF THE STUDY:

The purpose of this study has been to examine potential new energy conservation opportunities (ECO), as well as re-evaluate certain ECO previously studied on a comprehensive basis. Selected special studies have also been undertaken. The end product of this project will result in four (4) applications to the Federal "Energy Conservation Investment Program" (ECIP) for funding of energy improvements. Further, it is assumed that other energy conservation applications, on an annual basis, will be forthcoming in the future to further implement the Fort Lewis Energy Program.

1.2 HISTORY/CONTEXT:

A Base Wide Energy Plan was commenced by the John Graham Co. in 1978 at Fort Lewis, Yakima Firing Center, Vancouver Barracks and Camp Bonneville, reaching substantial completion in 1981. Several special studies, such as a Basewide Energy Monitoring and Control System study (EMCS) were submitted, as late as, 1983. The Base Wide Energy Plan is broad and comprehensive, looking at larger energy issues with several, more detailed concerns addressed. The Plan was the basis for approximately eight ECIP projects, of which half have been submitted for funding consideration by Fort Lewis.

1.3 RELATIONSHIP TO OTHER PLANS/PROJECTS:

The Fort Lewis Base Wide Energy Plan was considered as the basic overall document, from which specific, more detailed studies and implementation projects could be evolved. The plan to date, has been the basis for the Corps of Engineers, Project PN470 and a project by Associated Engineers. Both projects entailed 3 to 6 specific energy improvements, such as insulation, weather stripping, boiler controls, thermostats, and high bay fans for redistribution of warm air. Second, DEH, in its program of facilities upgrading, has instituted compliance to Washington State Energy Code Requirements. In the course of the Limited Building Survey most of this activity has appeared to be centered at the North Fort Lewis Enclave. Other cases of weatherstripping of entry doors have been observed over the larger Fort Lewis Area.

1.4 PRIMARY STUDY ELEMENTS:

This Energy Savings Opportunity Survey (ESOS) comprehensively inventories, analyzes, evaluates, and makes recommendations from a list of 43 energy conservation opportunities (ECO) on a representative group of 91 buildings that represent a larger building population (1,400 buildings) at Fort Lewis. Family housing has been excluded from the study, having been covered under previous studies. In addition, four special areas of interest are being studied. The main blocks of this study are comprised of:

1. A limited building survey of 91 representative buildings, and extending the limited building survey results to approximately 1400 other buildings on the Post.
2. Re-evaluate two previously prepared, but unsubmitted ECIP projects.
3. Evaluate consolidation of Central Distribution Plants #9 and #10 to improve plant efficiency.
4. Re-evaluation of an Energy Monitoring & Control System (EMCS) for North Fort and the Logistics Center.
5. Evaluate the feasibility of limited hydropower at the Central Sewage Treatment Plant System site.
6. Preparation of 4 Project Development Brochures (PDB) for specific energy improvements for consideration of funding by ECIP.

1.5 STUDY AREAS/ LOCATION:

The study area for the Fort Lewis ESOS Study includes the Logistics Center, Main Fort, and North Fort areas, exclusive of family housing. The total study area comprises approximately 4600 acres, of which Main Fort is 2600 acres; Logistics Center, 700 acres; and North Fort, 1300 acres. There are 4,930 buildings and various types of structures on the Fort. Of this total, approximately 2090 buildings are used for family housing, 1400 buildings of various uses with full active occupancy, and about 1440 structures of various types that are not heated or heated so infrequently as not to be a factor for energy consumption. Excluded also are buildings with more or less full use as mess halls. DEH has begun a special energy analysis in the future on this building type, which are primarily located in North Fort.

For purposes of conducting the limited building survey and analysis/evaluation, the Fort was divided into three zones. These zones are characterized by distinct boundaries, such as Interstate 5, or separated by large areas of open space. In addition, the three zones have markedly different construction or use. See the Limited Building Survey Map on page 4 for the locations.

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ZONE I is located at Main Fort, being characterized by large buildings constructed of brick, concrete, and steel. Type I permanent construction is common with a significant number having been constructed in the 1930's and 1940's. Buildings surrounding Gray Army Air Field appear to have been constructed between 1950 and 1970. Roughly 20% of the buildings in this zone are wood construction with some being listed as Temporary (T).

ZONE II is located at the Logistics Center, east of Main Fort. The dominant building type in the area are large warehouse structures between 100,000 and 250,000 square feet, with representations of concrete and heavy timber construction. Support buildings, a minority type, are dominantly W W II wood construction with several concrete buildings such as the ADP Building.

ZONE III is located at North Fort in the main troop enclave and is comprised mostly of W W II light wood frame buildings of small size. With the exception of some improved buildings, the structures have few energy improvements.

1.6 SUMMARY OF SIGNIFICANT FINDINGS:

1.61 LIMITED BUILDING SURVEY, ECIP PROJECTS SELECTED:

Using the detailed chart of applicable ECOs (section 2.4) DEH selected the following four ECIP Packages (Appendices A, B, C, and D contain the complete Project Development Brochures):

<u>ECIP</u>							
<u>PN</u>	<u>FY90 COST (THOUSANDS)</u>	<u>SQ.FT. (THOUSANDS)</u>	<u>ENERGY SAVINGS (MILLIONS)</u>	<u>DOLLAR SAVINGS (THOUSANDS)</u>	<u>SIMPLE PAYBACK (YEARS)</u>	<u>S.I.R.</u>	<u>ANALYSIS DATE</u>
704 (ECO 1A, 16)	3506	3931.08	131708.77	854.410	3.1	5.7	12/19/85
705 (ECO 1B)	3952	4983.46	101112.91	676.720	4.7	3.8	12/19/85
706 (ECO 1C)	4480	6498.54	173046.54	1060.070	3.2	5.7	12/19/85
707 (ECO 3, 4, 42)	2748	13511.68	80670.49	563.304	3.7	4.6	12/19/86

1.62 RE-EVALUATION OF EXISTING PROJECTS (GRAHAM):

There was insufficient data available to evaluate ECIP Projects T-566 and T-567. In addition, should these projects be funded, there would be insufficient information to develop bidding documents or for a contractor to implement the project. It is recommended that new ECIP Projects for similar improvements be developed with new, complete information. Refer to the Interim Submittal for complete discussion of this element.

1.63 CONSOLIDATION OF
CENTRAL DISTRIBUTION PLANTS 9/10
TO IMPROVE PLANT
EFFICIENCY:

This analysis indicates that intertieing Heating Plants #9 and #10 would result in a simple payback, using fuel savings only, or greater than 120 years. If maintenance and operation savings are counted, then the simple payback may be reduced to between 10 and 20 years. Planned construction of a small solid waste incinerator and waste heat boiler adjacent to Plant #9 would adversely impact this intertie if it contributes heat to the Plant #9 distribution system during low load periods. We recommend not proceeding with this intertie for ECIP funding. Refer to the Interim Submittal for complete discussion of this element.

not done in EAPP Program

1.64 RE-EVALUATION OF
THE FEASIBILITY OF
EMCS APPLICATIONS

North Fort Lewis: The application of an EMCS to control buildings which are unoccupied for long periods of time appears to be an attractive option with simple payback in the one year range. A modified load control area network EMCS was estimated as the most cost effective system. The system is based on 22 centrally located load control panels (LCP). Each LCP will control approximately 18 buildings via communication cable on telephone poles (requested as comment to Interim Submittal and included as Appendix I) connected to low voltage override thermostats in the buildings. A central micro computer would communicate with (call-up) the LCPs and initiate reset schedules via non-dedicated telephone lines.

Logistics Center: Due to the presence of digital setback thermostats and regular occupancy of these buildings, there does not appear to be an application for a central EMCS system in this area.

1.65 LIMITED HYDROPOWER
FEASIBILITY
EVALUATION:

The construction of a small hydroelectric facility on the sewage treatment plant outfall appeared to be a feasible option from Energy Savings only. The simple payback for this is about 14 years. This project became unfeasible due to legal and regulatory uncertainties. Refer to Interim Submittal for complete discussion.

1.66 BOILER SURVEY
RESULTS:

The boiler plants surveyed revealed the following energy conservation opportunities:

Insulation of pipes, valves, boiler surfaces, tanks, and condensate receivers.

Burner replacement with more efficient oil-gas combination burners.

Regular preventive maintenance by boiler controls professionals.

Rebuilding and refurbishing oxygen trim controls as required.

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Under Contract MOD 2 (Appendix I), additional "in-depth" studies of the boiler oxygen trim controls and boiler reset (on outdoor air temperatures) were performed. The small boilers show very poor paybacks due to the high cost of commercially available oxygen monitors. The outdoor reset control looks more promising for small hot water boilers, depending on the existing boiler control system and temperature setpoint.

1.7 SUMMARY OF CONTRACT MODIFICATIONS:

The following modifications were made to the base contract:

MOD 1 - Schedule revision.

MOD 2 - In-depth building studies - See Appendix I for results.

MOD 3 - Schedule revision.

MOD 4 - Computer generated chart - See Appendix I for results.

2.0 LIMITED BUILDING SURVEY:

2.1 SURVEY PROCESS: BC&S personnel conducted the Limited Building Survey on 91 buildings during October, November, and December, 1984 at Fort Lewis. The survey was conducted on a zone by zone basis, so the team members could gain solid familiarity with the survey zone, as well as the individual buildings. Each zone was further broken down into survey units, which was defined as the number of buildings that a 1-2 person team could survey in one day. Each 2 person team contained a senior professional; however, in the instance of complex buildings, two senior professionals were employed. Of the 91 buildings surveyed, 8 buildings were specially designated for investigation of boilers only. A senior engineer with special experience in boilers performed this work, in addition to the evaluation of Central Distribution Plants #9 and #10. A comprehensive list of 43 Energy Conservation Opportunities (ECO) developed by the Corps of Engineers (CE) formed the basis of the investigations. In some instances, all 43 ECO were investigated, while in other instances, fewer were studied at Seattle District Corps of Engineers' direction due to special characteristics of the buildings.

2.2 EXISTING CONDITIONS SUMMARY: Fort Lewis should be considered more or less fully developed, unless a dramatic change were to occur in its mission. The general average age of the structures is in the area of 30 years old. The fort, as a whole, is well maintained, considering the age of the buildings.

2.3 MAINTENANCE ITEMS SUBMITTED TO FORT LEWIS: Per agreement with DEH, Fort Lewis at the exit interview, BC&S forwarded a list of maintenance items for DEH action, which were contained in the Interim Report Appendix, Section G. Most items contained in this list are minor in nature, with the exception of a defective rotating screen filter for the waste water heat recovery system at the Post Laundry. This item caused a significant energy use, which has since been repaired. There are some areas at Fort Lewis where maintenance and operations (M & O) is not clear and responsibilities appear to overlap. Single point responsibility for all M & O activity at the Fort would be desirable and should be considered. An active preventive maintenance program would result in considerable energy and mechanical and operations cost savings.

2.4 CHARTS OF APPLICABLE ECO: The ECO determined to be applicable were subjected to engineering analysis and Life Cycle Cost Studies performed per TM5-800-3, AR415-15, and associated ECIP guidance provided by the government. These ECO are listed in the following table by Savings-to-Investment Ratio (SIR):

ECO #	DESCRIPTION	(THOUSANDS)		
		# BLDGS.	TOTAL SQUARE FT.	SIR
22	Install low GPM showerheads	360	4462.29	108.5
17	Night setback/set up thermostats	428	4771.96	67.3
11	Reduce light level	64	456.17	39.4
46	Insulate Domestic Hot Water pipes	548	2636.96	29.8
32	Insulate condensate lines	3	41.38	20.7
25	Prevent air stratification	95	1004.37	13.8
48	Insulate supply ducts	388	1086.03	12.7
3 *	Weatherstripping and caulking	1177	6519.86	10.9
1A *	Insulate floors	863	3232.03	9.0
44	Pool covers	3	N/A	8.1
1C *	Insulate roofs	1200	6498.54	5.7
47	Insulate Domestic Hot Water tanks	224	2776.20	4.2
26	Install electronic timing devices	15	436.91	3.8
1B *	Insulate walls	1036	4983.46	3.8
12	Replace incandescent lighting	659	6061.75	3.8
4 *	Insulate panels	22	1579.44	2.8
20	Radiator controls	37	388.87	2.4
16 *	Radiant heat (Natural Gas)	72	699.05	1.6
2	Install storm windows	1014	5390.72	1.4
41	Heat pumps	796	3734.56	1.3
42 *	Instantaneous Hot Water Heaters	871	5412.38	1.2
28	Revise boiler controls	81	1173.13	1.01
19	Control Hot Water Circulation Pump	79	2311.60	.75
13	Use more efficient lighting source & light sensors	84	1477.39	.21
9	Shutdown energy to hot water heaters or modify controls		(Payback beyond acceptable range S.I.R. not calculated)	

* Selected by DEH for ECIP Application.

2.4 (cont'd):

As a result of the Interim Submittal Review Conference, charts were prepared containing complete summary information for each ECO. These charts follow:

		C1 BUILDINGS				C2 BUILDINGS				C1 AND C2 BUILDING TOTAL VEHICLES			
FLOOR LEVEL	BLDG.	BLDG. AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MILL BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	TOTAL AREA (1000 SQ FT)	BLDG. AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MILL BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	SEVERE/INVEST RATIO
	LR2	4.91	2.3	238.00	3,675	1,620	6	22.28	27.19	2.3	1317.97	20,350	6.971
	2R17	6.19	2.4	180.00	3,060	1,208	322	621.13	629.32	2.4	13831.21	236,730	92.822
	3R35	14.66	3.0	546.00	10,980	3,720	2	26.72	41.38	3.0	1542.21	31,033	10.504
	6R10	4.70	1.6	164.00	1,770	1,116	-	-	4.70	1.6	164.00	1,770	1.118
	6R32	4.70	1.6	164.00	1,770	1,116	231	1036.80	1041.50	1.6	36341.70	392,224	247.700
	5B8	4.70	1.6	164.00	1,770	1,116	-	-	4.70	1.6	164.00	1,770	1.118
	5B31	4.70	1.6	164.00	1,770	1,116	-	-	4.70	1.6	164.00	1,770	1.118
	5B32	4.70	1.6	164.00	1,770	1,116	-	-	4.70	1.6	164.00	1,770	1.118
	10R8	14.65	2.4	463.00	7,625	3,154	12	31.06	45.71	2.4	1444.62	23,795	9.843
	1E4	4.72	1.6	164.00	1,770	1,116	-	-	4.72	1.6	164.00	1,770	1.118
	1E6	4.72	2.5	103.00	1,770	702	162	724.50	729.22	2.5	15913.06	273,450	109.574
	1E20	7.67	1.6	270.00	2,876	1,815	-	-	7.67	1.6	270.00	2,876	1.815
	2E4	2.28	2.5	99.50	1,713	680	-	-	2.28	2.5	89.50	1,713	-680
	3E4	3.78	2.0	206.00	2,634	1,407	8	39.82	43.60	2.0	2376.08	32,699	16.234
	F2	9.83	2.4	448.00	7,380	3,053	62	309.41	319.24	2.4	14549.29	239,647	99.138
	1J6	2.00	2.4	89.90	1,500	613	6	37.98	39.98	2.4	1787.55	29,392	12.257
	10J3	11.99	6.3	250.00	8,990	1,700	10	70.70	82.68	6.3	1724.14	62,011	11.726
	22J0	3.72	3.1	132.00	2,786	900	5	19.59	23.70	3.1	840.96	17,774	5.742
	24J9	7.67	2.5	167.00	2,876	1,410	4	25.23	32.90	2.5	716.34	12,337	4.890
	5D38	13.32	1.6	926.00	9,868	6,308	12	120.63	133.94	1.6	9311.44	100,459	63.446
	5D99	8.18	1.6	568.00	6,134	3,870	-	-	8.18	1.6	568.00	6,134	3,870
	TOTAL	146.78	2.2	5670.40	84,817	36,598	842	3086.26	3232.03	2.1	103464.07	1492,074	704,802
													9.0

INSTR.	C1 BUILDINGS						C2 BUILDINGS						C1 AND C2 BUILDING TOTAL VEHICLES					
	BLDG #	BLDG AREA (1000 SQ FT)	PAYOUT (YR)	ENERGY SAVINGS (MWH BTU/YR)	CONST. COST (\$1000)	ECOST/SAVE (\$1000/yr)	BLDG AREA (1000 SQ FT)	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PAYOUT (YR)	ENERGY SAVINGS (MWH BTU/YR)	CONST. COST (\$1000)	ECOST/SAVE (\$1000/yr)	CONST. COST (\$1000)	ECOST/SAVE (\$1000/yr)	SAVE/INVEST RATIO		
1R2	4.91	4.1	75.10	2.116	.511		6	22.28	27.19	4.1	415.60	11.710	2.828					
1R24	8.00	2.8	168.00	3.266	1.148		29	202.61	210.61	2.8	451.81	87.808	30.863					
2R17	8.19	4.6	170.00	5.325	1.160		322	621.13	629.32	4.6	13154.50	411.595	69.769					
3R2	11.19	4.2	62.60	2.375	.562		1	11.71	22.89	4.2	169.06	4.361	1.150					
3R10	22.33	5.2	110.00	3.770	.720		-	22.33	5.2	110.00	3.770	1.720						
3R35	14.65	6.0	123.00	5.070	.840		2	26.72	41.38	6.0	347.32	14.316	2.372					
6R10	4.70	2.8	117.00	2.267	.797		-	-	4.70	2.8	117.00	2.267	.797					
6R32	4.70	2.8	117.00	2.267	.797		231	1036.80	1041.50	2.8	26915.60	502.358	176.600					
1R16	3.11	4.3	49.00	1.444	.334		-	-	3.11	4.3	49.00	1.444	.334					
5R8	4.70	2.8	117.00	2.267	.797		-	-	4.70	2.8	117.00	2.267	.797					
6R31	4.70	2.8	117.00	2.267	.797		-	-	4.70	2.8	117.00	2.267	.797					
6R32	4.70	2.8	117.00	2.267	.797		-	-	4.70	2.8	117.00	2.267	.797					
1R88	14.66	4.3	241.00	7.125	1.642		12	31.06	45.71	4.3	752.08	22.235	5.124					
1C14	3.11	4.4	58.20	1.734	.397		11	99.46	102.57	4.4	1820.75	57.226	13.102					
1E4	4.72	2.8	89.00	1.730	.608		-	-	4.72	2.8	89.00	1.730	.608					
1E6	4.72	4.5	56.00	1.730	.380		162	724.50	729.22	4.5	8768.71	269.545	58.505					
1E20	7.67	2.9	95.00	1.826	.640		-	-	7.67	2.9	95.00	1.826	.640					
2C4	2.28	4.5	98.00	3.024	.668		-	-	2.28	4.5	98.00	3.024	.668					
3E34	3.78	3.6	69.00	2.200	.608		8	39.82	43.60	3.6	1026.30	25.384	7.016					
F2	9.63	4.3	91.50	2.411	.555		62	309.41	319.24	4.3	2546.51	78.281	18.022					
14S	2.00	4.4	42.20	1.264	.297		6	37.59	39.99	4.4	843.77	25.273	5.738					
4R31	4.72	4.5	25.00	.781	.175		31	159.03	163.75	4.5	867.29	27.094	6.071					
10R3	11.98	3.7	146.00	3.710	.993		10	70.70	82.68	3.7	1007.07	25.591	6.849					
12E3	34.73	6.9	240.70	11.258	1.640		-	-	34.73	6.9	240.70	11.258	1.640					
20R2	37.99	2.9	650.00	12.759	4.420		-	-	37.99	2.9	650.00	12.759	4.420					
20E6	5.85	1.8	422.00	5.274	2.877		3	24.66	30.51	1.8	2202.25	27.323	16.014					
22T0	3.72	.9	294.00	1.896	2.009		5	19.99	23.70	.9	1975.66	12.396	12.817					
24R9	7.67	4.6	65.00	2.662	.580		4	25.23	32.90	4.6	364.52	11.419	2.488					
30R1	20.97	20.1	58.00	5.185	.258		-	-	20.97	20.1	58.00	6.185	.258					
31T0	3.17	17.4	186.00	15.720	.902		-	-	3.17	17.4	186.00	15.720	.902					
32R4	12.44	13.6	455.00	29.950	2.206		8	32.63	45.07	13.6	1648.46	108.510	7.982					
32T1	10.00	67.0	66.00	16.240	.320		2	18.53	28.53	67.0	186.26	52.033	.912					
32T7	2.68	14.2	150.00	10.330	.727		33	224.77	227.34	14.2	13227.90	910.363	64.060					
34T0	60.77	1.7	1250.00	10.483	.6256		6	356.08	405.85	1.7	11602.48	94.286	50.009					
36S3	50.77	1.9	1290.00	10.483	.5705		-	-	50.77	1.9	1290.00	10.483	.5705					
40E0	18.24	7.1	102.00	4.961	.696		22	123.79	142.03	7.1	794.25	36.630	5.420					
40T6	22.12	6.3	208.00	7.553	1.420		7	72.04	94.16	5.3	885.35	32.149	6.014					
42S0	74.36	2.3	540.00	8.538	3.690		1	14.87	89.32	2.3	648.72	10.258	4.433					
5102	15.73	3.2	101.00	1.920	.605		-	-	15.73	3.2	101.00	1.920	.605					
5038	13.32	2.9	177.00	3.480	1.204		12	120.63	133.94	2.9	1760.26	35.002	12.110					
5208	8.18	2.9	107.00	2.119	.735		-	-	8.18	2.9	107.00	2.119	.735					
TOTAL	667.95	4.3	8005.30	225.048	62.463		996	4425.54	4903.46	4.7	101112.91	2976.866	625.720	3.8				

ROW NO.	BLDG. NO.	C1 BUILDING WORKS			C2 BUILDING WORKS			C1 AND C2 BUILDING TOTAL WORKS			
		BLDG. AREA (1000 SQ FT)	PATRICK (1TR)	ENERGY SAVE (MWH BIU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	TOTAL AREA (1000 SQ FT)	BLDG. AREA (1000 SQ FT)	PATRICK (YR)	ENERGY SAVE (MWH BIU/YR)	CONST. COST (\$1000)
1A2	4-91	4-1	139-00	3-900	-946	6	22-28	27-19	4-1	768-22	21-583
1A24	8-00	2-9	155-00	3-048	1-059	29	202-51	210-61	2-9	4230-57	63-242
2A17	8-19	4-6	104-00	3-264	.711	322	621-13	629-32	4-6	6047-50	252-540
3A2	11-19	4-2	288-00	8-612	2-031	1	11-71	22-89	4-2	609-91	17-626
3A35	14-65	3-6	506-00	12-637	3-465	2	26-72	41-38	3-6	1434-45	35-683
6A10	4-70	2-9	93-00	1-823	.633	-	-	4-70	2-9	93-00	9-784
6A32	4-70	2-8	93-00	1-823	.633	231	1036-80	1041-50	2-9	20579-60	1-823
10A9	14-65	4-4	264-00	7-895	1-796	12	31-06	45-71	4-4	823-85	.633
1C14	3-11	5-9	81-50	3-276	.555	11	99-46	102-57	5-9	2689-71	108-116
1E4	4-72	2-9	94-80	1-860	.646	-	-	4-72	2-9	94-80	1-860
1E6	4-72	4-7	69-59	1-860	.400	162	724-50	729-22	4-6	9298-96	288-185
1E20	7-67	3-0	150-00	3-000	1-000	-	-	7-67	3-0	150-00	3-000
2E4	2-28	4-5	60-00	1-856	.408	-	-	2-28	4-5	60-00	1-856
3E34	3-78	4-9	122-00	4-050	.829	8	39-82	43-60	4-9	1407-66	46-730
F2	9-83	6-9	255-00	10-168	1-735	62	309-41	319-24	5-9	8280-48	330-180
IJ6	2-00	4-4	54-40	1-650	.371	6	37-99	39-99	4-4	1087-70	32-981
4431	4-72	4-6	58-00	1-860	.400	31	159-03	163-75	4-6	2046-87	64-528
1010	20-10	4-8	240-00	7-952	1-632	12	121-91	142-01	4-9	1686-63	56-182
1020	16-74	2-8	716-00	14-060	4-882	3	59-79	78-53	2-9	3000-28	58-916
1033	11-99	.3	527-00	1-030	3-590	10	70-70	82-68	.3	3635-10	7-105
1212	10-16	2-9	450-00	9-767	3-046	22	207-71	217-87	2-9	9645-91	187-384
1253	3-473	1-8	2835-00	34-726	19-325	-	-	34-73	1-8	2635-00	34-726
1450	33-18	4-5	250-00	7-650	1-700	2	3-98	37-16	4-5	278-98	6-568
2006	46-61	7-9	150-00	10-050	1-270	15	293-66	340-27	7-9	1307-04	73-367
2022	37-99	2-3	910-00	14-553	6-200	-	-	37-99	2-3	910-00	14-553
2045	14-95	3-8	607-00	15-887	4-140	6	93-37	108-33	3-8	4387-56	115-100
2050	5-85	2-6	346-00	6-222	2-360	3	24-66	30-51	2-6	1805-64	35-470
2063	7-38	9-5	66-00	5-540	.586	19	122-40	129-78	9-5	1511-72	97-363
2109	14-13	16-1	95-50	10-600	.660	-	-	14-13	16-1	96-60	10-600
2161	28-67	2-1	780-00	10-875	5-300	1	22-93	61-60	2-1	1403-91	19-574
2270	3-72	6-3	68-00	2-937	.464	5	19-99	23-70	6-3	433-83	18-738
2409	7-67	7-1	98-00	3-072	.434	4	25-23	32-90	7-1	420-39	13-178
3170	3-17	19-3	25-30	2-381	.123	-	-	3-17	19-3	25-30	2-381
3204	12-44	4-4	432-00	9-329	2-095	6	32-63	45-07	4-4	1565-15	33-759
3226	6-50	1-5	550-00	4-124	2-667	-	-	5-50	1-5	550-00	4-124
3271	10-00	4-1	360-00	7-500	1-843	2	18-53	28-63	4-1	1084-03	21-395
3277	2-50	2-8	140-00	1-935	.679	33	224-77	227-34	2-8	12346-10	170-640
3434	6-40	1-5	560-00	4-124	2-668	38	190-78	197-19	1-5	17821-10	133-567
3470	50-77	1-4	1800-00	12-632	9-118	6	355-08	405-85	1-4	16909-04	114-154
3653	60-77	1-5	1800-00	12-632	8-330	-	-	50-77	1-5	16800-00	128-682
3760	31-16	5-2	18-00	4-20	.080	7	50-68	67-83	5-2	42-56	.983
3811	17-98	10-8	280-90	13-470	1-244	4	25-00	42-96	10-8	671-95	32-222
4060	18-24	1-3	1630-00	14-045	11-100	22	123-79	142-03	1-3	12682-40	109-365
4076	22-12	3-1	773-00	16-591	5-267	7	72-04	94-16	3-1	3280-27	70-860
4290	74-35	2-8	684-00	16-765	6-095	1	14-97	69-32	2-8	1073-98	20-164
9603	23-05	14-4	200-00	19-590	1-363	1	1-52	24-56	14-4	213-16	.189
9604	6-91	3-2	302-00	6-585	2-681	16	44-78	53-69	3-2	1819-22	40-270

C1 AND C2 BUILDING WINDLES													
C1 BUILDINGS		C2 BUILDINGS		C1 BUILDING WINDLES									
INSTANT L STORM WINDONS	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVG (MLN BTU/yr)	CONST. COST (\$1000)	ECOST. SAVG (\$1000/YR)	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVG (MLN BTU/yr)	CONST. COST (\$1000)	ECOST. SAVG (\$1000/YR)	SAVE/INVEST RATIO
1R2	4.91	20.7	49.60	7.008	.338		6	22.28	27.19	20.7	274.67	38.808	1.870
2R17	8.19	80.00	6.352	.544		322	621.13	829.32	15.4	6147.20	644.153	41.971	
3R35	14.65	30.40	3.728	.210		2	26.72	41.38	17.8	85.86	10.527	.683	
6A10	4.70	9.7	81.00	5.312	.550		-	-	4.70	9.7	81.00	5.312	.550
6A32	4.70	9.7	76.40	5.024	.520	231	1036.80	1041.50	9.7	16929.91	1113.300	115.200	
1B16	3.11	15.4	13.00	1.312	.085		-	-	3.11	15.4	13.00	1.312	.085
6B8	4.70	9.7	65.10	5.600	.580		-	-	4.70	9.7	65.10	5.600	.580
6B31	4.70	9.7	80.80	5.310	.550		-	-	4.70	9.7	80.80	5.310	.550
6B32	4.70	14.5	80.80	7.968	.550		-	-	4.70	14.5	80.80	7.968	.550
10B8	14.65	14.7	137.00	13.760	.934	12	31.06	46.71	14.7	427.46	42.940	2.915	
1C14	3.11	14.8	14.20	1.440	.087	11	99.46	102.57	14.8	468.32	47.524	3.201	
1E4	4.72	9.7	71.50	4.704	.487		-	-	4.72	9.7	71.50	4.704	.487
1E6	4.72	15.4	44.00	4.704	.305	162	724.50	729.22	15.4	6797.81	734.716	47.671	
1E20	7.67	9.6	120.00	7.800	.810		-	-	7.67	9.6	120.00	7.800	.810
2E4	2.28	14.2	28.00	2.696	.190		-	-	2.28	14.2	28.00	2.696	.190
3E34	3.78	18.4	27.50	3.465	.188	8	39.82	43.60	18.4	317.19	39.980	2.169	
P2	9.83	14.7	61.40	6.168	.419	62	309.41	319.24	14.7	199.03	200.280	13.606	
I.5	2.00	14.8	17.00	1.728	.116	6	37.98	38.98	14.8	339.91	34.551	2.319	
4301	20.69	15.4	79.50	8.320	.542	7	23.49	44.18	15.4	169.75	17.766	1.157	
4431	4.72	15.4	53.00	5.536	.360	31	159.03	163.75	15.4	1836.71	182.053	12.489	
1010	20.10	14.5	153.00	15.120	1.043	12	121.91	142.01	14.5	1080.97	106.825	7.400	
1020	18.74	15.2	355.00	36.650	2.418	3	59.79	78.53	15.2	1467.62	149.391	10.132	
1033	11.99	14.5	200.00	19.560	1.351	10	70.70	82.69	14.5	1379.31	134.920	9.317	
1212	10.16	14.6	41.60	4.104	.284	22	207.71	217.87	14.5	682.06	87.971	6.088	
1450	33.18	14.5	102.00	10.080	.695	2	3.98	37.16	14.5	114.23	11.288	.778	
2001	30.75	9.7	150.00	9.608	.995	1	2.83	33.59	9.7	163.85	10.493	1.087	
2050	5.86	9.6	60.50	3.984	.413	3	24.66	30.51	9.6	316.53	20.791	2.165	
2109	14.13	13.7	563.00	51.760	.3765	-	-	-	14.13	13.7	563.00	51.760	3.765
2409	7.67	23.0	73.00	11.520	.500	4	25.23	32.90	23.0	313.13	49.417	2.145	
3277	2.58	13.4	54.00	3.520	.262	33	224.77	227.34	13.4	4768.28	310.415	23.086	
4280	74.36	9.7	1320.00	86.300	6.942	1	14.97	69.32	9.7	1565.77	103.674	10.742	
5038	13.32	9.6	63.00	4.176	.433	12	120.63	133.94	9.6	633.50	42.002	4.355	
5209	8.18	9.7	81.60	5.368	.555	-	-	-	8.18	9.7	81.60	5.368	.555
6071	6.90	9.7	66.00	5.658	.586	1	15.40	22.30	9.7	107.94	18.290	1.894	
9630	285.38	13.1	1100.00	86.400	6.603	-	-	-	285.38	13.1	1100.00	86.400	6.603
9640	261.73	28.2	1100.00	172.800	6.603	7	300.92	562.64	28.2	2364.67	371.467	14.195	
8641	45.68	9.6	153.00	10.080	1.045	5	43.43	69.11	9.6	298.46	19.663	2.039	
8086	36.89	11.6	299.88	19.730	1.700	-	-	-	36.89	11.6	299.89	19.730	1.700
TOTAL	1022.11	14.3	7175.78	666.353	46.668	976	4368.62	5390.72	13.3	54050.82	4767.176	356.999	1.4

C1 AND C2 STANDING TOTAL VEHICLES

C1 AND C2 BUILDING TOTALS									
C1 BUILDINGS		C2 BUILDINGS		C1 BUILDING VEHICLES		C2 BUILDING VEHICLES		C1 AND C2 BUILDING TOTAL VEHICLES	
INDUL. PANEL	BLDG	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)
6E0	3H2	11.18	7.6	2.20	-11.4	-.016	1	11.71	22.89
10B8	14.65	7.9	22.30	1.200	-152	-250	12	31.06	45.71
1E4	4.72	5.2	42.90	1.512	-292	-250	-	-	4.72
12E3	34.73	5.0	515.00	17.400	3.500	-250	-	-	34.73
2045	14.96	6.8	3.50	1.62	-.024	-250	6	93.37	108.33
2050	5.85	5.1	44.00	1.530	-.300	-250	3	24.66	30.51
2063	7.39	5.1	9.20	.324	-.063	-250	19	122.40	129.78
2161	28.67	6.9	168.00	7.926	1.145	-250	1	22.93	61.60
3063	42.09	8.0	640.00	22.560	2.635	-250	2	24.20	66.29
3041	20.97	8.2	110.70	4.000	-.490	-250	-	-	20.97
3170	3.17	11.0	10.30	.552	-.050	-250	-	-	3.17
3271	10.00	7.2	230.00	8.010	1.116	-250	2	19.53	26.53
3277	2.58	7.1	20.10	.695	-.097	-250	33	224.77	227.34
3750	37.15	12.9	6.00	-.335	-.026	-250	7	50.68	87.83
3911	17.36	8.0	31.80	1.122	-.141	-250	4	26.00	42.96
4060	16.24	5.2	240.00	8.400	1.625	-250	22	123.79	142.03
4076	22.12	11.0	60.70	4.536	-.414	-250	7	72.04	94.16
5102	15.73	8.8	9.80	-.528	-.060	-250	-	-	15.73
5208	13.32	6.1	23.00	.810	-.158	-250	12	120.63	133.94
5209	8.18	5.2	69.00	2.430	-.470	-250	-	-	8.18
6071	6.90	4.9	41.80	1.406	-.285	-250	1	15.40	22.30
9560	257.74	4.2	82.1	2.340	-.560	-250	-	-	257.74
TOTAL	6598.29	6.4	2392.50	67.922	13.818	-250	132	961.17	1679.44
								6.4	7652.06
									286.489
									44.835
									2.6

C1 AND C2 BUILDING TOTALS									
C1 BUILDINGS		C2 BUILDINGS		C1 BUILDING VEHICLES		C2 BUILDING VEHICLES		C1 AND C2 BUILDING TOTAL VEHICLES	
INDUL. CONTROLS	BLDG	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)
1A2	4.91	94.0	.29	-.250	-.003	-250	6	22.26	27.19
2A17	8.19	94.0	.29	-.250	-.003	-250	322	621.13	629.32
3B2	11.19	94.0	.29	-.250	-.003	-250	1	11.71	22.89
3H10	22.33	94.0	.29	-.250	-.003	-250	-	22.33	94.0
7H11	3.87	94.0	.29	-.250	-.003	-250	-	-	3.87
6B32	4.70	94.0	.29	-.250	-.003	-250	-	-	4.70
10B8	14.65	195.0	.29	-.250	-.001	-250	12	31.06	45.71
1C14	3.11	94.0	.29	-.250	-.003	-250	11	99.46	102.57
1E4	4.72	94.0	.29	-.250	-.003	-250	-	-	4.72
1E6	4.72	94.0	.29	-.250	-.003	-250	162	724.50	729.22
1E20	7.67	94.0	.29	-.250	-.003	-250	-	-	7.67
2E4	2.28	94.0	.29	-.250	-.003	-250	-	-	2.28
F2	9.83	94.0	.29	-.250	-.003	-250	62	309.41	319.24
4431	4.72	94.0	.29	-.250	-.003	-250	31	158.03	163.75
2109	14.13	195.0	.29	-.250	-.001	-250	-	-	14.13
2161	28.67	94.0	.29	-.250	-.003	-250	1	22.93	51.60
2270	3.72	195.0	.29	-.250	-.001	-250	5	19.99	23.70
3238	8.63	195.0	.29	-.250	-.001	-250	3	16.42	195.0
3271	10.00	195.0	.29	-.250	-.001	-250	2	18.53	195.0
4290	74.36	94.0	.29	-.250	-.003	-250	1	14.97	88.32
9630	286.38	195.0	.29	-.250	-.001	-250	-	-	286.38
TOTAL	531.77	103.0	6.08	6.250	.051	-250	619	2071.42	2603.17
									81.509
									1.050

REDUCE REFUGIUM LEVEL	C1 BUILDING VARIATIONS			C2 BUILDING VARIATIONS			C1 AND C2 BUILDING TOTAL VARIATIONS						
	BLDG	BLDG AREA (1000 SQ FT)	FRYBRICK (YR)	BLDG AREA (1000 SQ FT)	FRYBRICK (YR)	BLDG AREA (1000 SQ FT)	FRYBRICK (YR)	CONST. COST (\$1000)	ENERGY SAVE (\$1000/yr)	CONST. COST (\$1000)	ENERGY SAVE (\$1000/yr)	CONST. COST (\$1000)	ENERGY SAVE (\$1000/yr)
2163	17.59	1.4	65.80	-	-	-	-	-	-	17.59	1.4	65.80	-
2272	36.26	2	740.00	-160	.955	-	-	-	36.26	-	740.00	-160	-
3114	33.46	3.1	54.20	-360	-117	-	-	33.46	3.1	54.20	-360	-	-117
3277	2.58	-2	163.00	-60	-34.0	33	224.77	227.34	-	14382.95	6.281	29.983	-
3750	37.15	7.2	34.80	-540	-75	7	50.68	87.63	7.2	82.87	1.277	-	-177
9504	6.91	3.6	60.00	-702	-194	18	44.78	53.69	3.6	301.29	4.229	1.169	-
Total	135.95	1.1	1107.80	2.372	2.086	56	-23	456.17	0.36	15607.11	11.867	32.806	39.4

C1 AND C2 BUILDING TOTAL VEHICLES													
C1 BUILDINGS		C2 BUILDINGS		C1 BUILDING VEHICLES		C2 BUILDING VEHICLES		C1 AND C2 BUILDING TOTAL VEHICLES					
REPLACE- MENTS LIGHTS	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ECOST. COST (\$1000)	ENERGY SAVE (MLN BTU/YR)	ECOST. SAVE (\$1000/YR)	SAVE/INVEST RATIO
3A2	11-19	3-4	109.00	.670	-200		1	11.71	22.69	3-4			
3A10	22-33	6-1	42.00	1-308	.211		-	-	22.33	6-1	42-00	1-330	.211
3R35	14-65	2-8	957.00	7-255	2-550		2	26.72	41-38	2-8	2703-11	20-486	7-200
6A10	4-70	3-7	30-70	.330	.088		-	-	4-70	3-7	30-70	.930	.088
6A32	4-70	3-0	18-90	.150	.050		231	1036-80	1041-50	3-0	4188-16	33-239	11-079
5B8	4-70	3-9	30-70	.330	.085		-	-	4-70	3-9	30-70	.330	.085
5B31	4-70	5-1	12-00	.160	.035		-	-	4-70	5-1	12-00	.180	.035
6B32	4-70	7-5	11-80	.270	.036		-	-	4-70	7-5	11-80	.270	.036
10B8	14-65	3-6	31-90	.276	.077		12	31-06	45-71	3-6	19-53	.868	.240
1C14	3-11	2-9	22-10	.170	.059		11	99-46	102-57	2-9	728-87	5-610	1-947
1E4	4-72	6-1	6-60	.110	.018		-	-	4-72	6-1	6-57	.110	.018
1E20	7-67	4-7	63-00	1-030	.216		-	-	7-67	4-7	63-00	1-030	.216
2E4	2-28	6-7	2-30	.040	.006		-	-	2-28	6-7	2-30	.040	.006
3E34	3-78	2-8	70-80	.540	.193		8	39-82	43-60	2-8	816-63	6-231	2-227
4301	20-69	4-6	20-50	.280	.061		7	23-48	44-18	4-6	43-77	.598	.130
4431	4-72	7-2	12-50	.280	.039		31	159-03	163-75	7-2	433-66	8-714	.353
1450	33-18	2-4	253-30	2-585	1-071		2	3-98	37-16	2-4	263-66	2-906	1-188
2022	37-99	6-0	61-30	1-040	.210		-	-	37-98	5-0	61-30	1-040	.210
2045	14-95	3-6	34-00	.235	.065		6	93-37	108-33	3-6	246-36	1-703	.471
2108	14-13	3-3	50-30	.440	.135		-	-	14-13	3-3	50-30	.440	.135
2161	26-67	2-3	250-00	1-065	.473		1	22-93	51-60	2-3	449-94	1-817	.851
2163	17-59	4-3	75-00	.670	.155		-	-	17-59	4-3	75-00	.670	.155
2270	3-72	4-1	1-90	.070	.017		5	19-99	23-70	4-1	12-10	.447	.108
2409	7-67	9-1	6-80	.410	.045		4	25-23	32-90	9-1	29-17	1-759	.193
3119	42-85	3-5	18-90	.180	.051		-	-	42-85	3-5	18-90	.180	.051
3114	33-46	3-5	18-90	.180	.051		-	-	33-46	3-5	18-90	.180	.051
3161	33-46	3-5	18-90	.180	.051		562	1627-20	1680-70	3-5	936-05	9-284	2-531
3204	12-44	5-3	61-90	.810	.152		8	32-63	46-07	6-3	224-26	2-935	.551
3238	8-63	3-1	31-40	.240	.077		3	16-42	25-05	3-1	91-14	.697	.224
3271	10-00	3-8	15-80	.160	.042		2	18-53	28-53	3-8	45-07	.456	.120
3277	2-58	6-5	12-70	.255	.039		33	224-77	227-34	6-5	1119-08	22-487	3-139
3470	50-77	3-3	50-30	.440	.135		6	355-06	405-65	3-3	402-09	3-957	1-214
3653	50-77	3-3	50-30	.440	.135		-	-	50-77	3-3	50-30	.440	.135
3750	37-15	4-1	433-70	4-055	.991		7	50-68	87-63	4-1	1025-35	9-588	2-343
4080	18-24	3-7	355-00	2-580	.725		22	123-79	142-03	3-7	2764-29	20-668	5-645
4076	22-12	4-8	45-00	.600	.125		7	72-04	94-16	4-8	191-56	2-544	.632
4290	74-35	2-3	171-50	1-175	.510		1	14-87	89-32	2-3	206-03	1-412	.613
5038	13-32	2-6	67-00	.465	.176		12	120-63	133-94	2-6	673-72	4-677	1-770
6137	6-56	3-5	18-90	.180	.051		83	277-60	286-17	3-5	631-85	6-016	1-705
5208	8-18	5-2	6-40	.200	.038		-	-	6-18	5-2	6-40	.200	.038
6071	6-90	2-9	11-40	.070	.024		1	15-40	22-30	2-9	36-84	.226	.076
8503	23-05	9-2	14-00	.330	.036		1	1-82	24-56	9-2	14-82	.362	.036
9604	8-91	3-0	27-00	.180	.060		18	44-78	53-69	3-0	162-69	1-085	.361
9641	45-68	5-2	663-70	5-775	1-115		5	43-43	89-11	5-2	1294-70	11-266	2-175
9660	207-52	4-6	65-50	.740	.162		2	42-68	250-21	4-6	78-98	.892	.186
9665	250-91	56-70	279-00	8-050	.142		27	79-96	330-87	56-7	367-91	10-615	.187
8909	6-09	4-4	11-60	.180	.041		-	-	6-09	4-4	11-60	.180	.041
8006	38-69	2-3	781-00	6-686	2-912		-	-	38-68	2-3	781-00	6-686	2-912
Total	1306-02	3-8	5406-20	53-993	13-938		611	4785-70	6081-76	3-8	21721-24	209-841	55-653

C1 AND C2 BUILDING TOTAL VARIABLES									
C1 BUILDINGS		C2 BUILDINGS		C1 BUILDING VEHICLES		C2 BUILDINGS		C1 AND C2 BUILDING TOTAL VEHICLES	
60 • 20 PREVENT AIR STRATIF.	BLDG AREA (1000 SQ FT)	CONST. COST (\$1000/yr)	CONST. COST (\$1000/yr)						
1A2	4.91	3.4	1.400	413	6	22-28	27-19	3.4	337.80
3A35	14.65	1.2	291.0	1.981	2	26-72	41-38	1.2	821.95
3063	42.08	9.6	424.0	18.000	2	24-20	66-29	9.6	6.777
3750	37.15	26.9	5.9	.026	7	50-68	87.33	26-349	2.863
6038	13.32	6.4	198.0	7.300	1.351	12	120-63	133.94	.061
5209	8.18	3.7	98.7	2.500	.670	-	8.18	5.4	13.565
9503	23.05	10.3	142.0	10.00	.970	1	1-52	24.56	.670
TOTAL	143.36	5.80	1220.6	42.300	7.286	30	246.03	386.87	5.0

C1 AND C2 BUILDING TOTAL VARIABLES									
C1 BUILDINGS		C2 BUILDINGS		C1 BUILDING VEHICLES		C2 BUILDINGS		C1 AND C2 BUILDING TOTAL VEHICLES	
60 • 20 LOW GPM SHOWER HEADS	BLDG AREA (1000 SQ FT)	CONST. COST (\$1000/yr)	CONST. COST (\$1000/yr)						
1A24	6.00	0.4	46.5	-335	29	202.61	210.61	0.4	1244.17
3A10	22.33	.08	484.1	-160	-	22-33	.08	484.1	3.159
6A10	4.70	.20	100.8	-130	-	-	4.70	.20	1.460
6A32	4.70	.20	100.8	-130	-	231	1036.80	1041.50	.720
5B8	4.70	.20	100.8	-130	-	-	4.70	.20	159.549
5B31	4.70	.20	100.8	-130	-	-	4.70	.20	.720
5B32	4.70	.20	100.8	-130	-	-	4.70	.20	.720
1E4	4.72	.10	65.9	-.070	-	-	4.72	.10	.720
1E20	7.67	.30	70.0	-.150	-	-	7.67	.30	.470
1O20	16.74	.60	55.8	-.315	-	3	59.79	78.53	.490
2006	46.61	.20	143.0	.200	15	293.66	340.27	.20	1.320
2007	76.95	.10	590.8	-.420	-	-	78.95	.10	1.860
2020	107.23	.10	887.3	-.650	6	347.57	454.79	.10	4.186
3119	42.85	.08	573.7	-.245	-	-	42.85	.08	2.757
3114	33.46	.16	299.5	-.280	-	-	33.46	.16	2.907
3161	33.46	.12	317.5	-.190	52	1627.20	1660.70	.12	1.537
3470	50.77	.18	487.7	-.425	6	355.08	405.85	.18	81.397
3653	60.77	.26	372.9	-.460	-	-	60.77	.25	18.906
4222	10.49	.90	80.6	-.490	-	-	10.49	.90	.460
TOTAL	539.55	0.15	4979.3	4.826	31.011	341	3922.71	4462.29	0.16

C1 AND C2 BUILDING TOTAL VARIABLES									
C1 BUILDINGS		C2 BUILDINGS		C1 BUILDING VEHICLES		C2 BUILDINGS		C1 AND C2 BUILDING TOTAL VEHICLES	
60 • 20 PREVENT AIR STRATIF.	BLDG AREA (1000 SQ FT)	CONST. COST (\$1000/yr)	CONST. COST (\$1000/yr)						
3A10	22.33	1.4	326.0	2.116	-	26-33	1.4	326.0	3.050
3A35	14.65	0.87	273.0	1.550	2	41-38	0.87	717.10	4.377
1B16	3.11	3.1	35.0	.620	-.197	-	3.11	.31	35.0
1C14	3.11	0.77	65.0	.310	-.354	11	89.46	102.57	0.87
3E34	3.78	1.0	63.5	.620	-.390	6	39.92	43.60	1.167
F2	9.83	0.5	184.0	.610	1.210	62	309.41	319.24	0.5
2022	37.99	0.5	493.0	1.860	3.165	-	37.99	0.5	687.60
3271	10.00	.92	208.0	.930	1.008	2	18.53	.87	1.860
9670	120.24	0.80	617.5	1.860	2.300	-	120.24	.80	633.42
8630	285.38	1.6	1630.0	24.800	16.360	-	285.38	1.6	1630.0
TOTAL	610.42	1.2	3766.00	27.865	85	493.94	1004.37	0.8	12007.983

108.5 108.5 108.5 108.5 108.5 108.5 108.5 108.5 108.5 108.5

		C1 BUILDINGS			C2 BUILDINGS			C1 AND C2 BUILDING TOTAL VEHICLES															
INSTALLED TIME	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	CONST. COST (\$1000/yr)	ENERGY SAVE (MIL BTU/yr)	ECOST. SAVE (\$1000/yr)	# OF BLDG	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PATBACK (YR)	ECOST. SAVE (MIL BTU/yr)	CONST. COST (\$1000)	ECOST. COST (\$1000)	ENERGY SAVE (MIL BTU/yr)	CONST. COST (\$1000)	ECOST. COST (\$1000)	ENERGY SAVE (MIL BTU/yr)	CONST. COST (\$1000)	ECOST. COST (\$1000)	ENERGY SAVE (MIL BTU/yr)	CONST. COST (\$1000)	ECOST. COST (\$1000)	ENERGY SAVE (MIL BTU/yr)
2163	17-59	1-9	20-0	-250	.135	-	-	-	17-59	1-9	20-0	-	-	-	-	-	-	-	-	-	-	-	-
6038	13-32	3-0	10-7	-219	.073	-	12	120-63	133-94	3-0	107-59	2-188	-250	-	-	-	-	-	-	-	-	-	-
9630	285-38	7-1	28-00	-260	.035	-	-	-	285-38	7-1	28-00	-260	-	-	-	-	-	-	-	-	-	-	-
TOTAL	316-29	2-96	58-70	-719	.243	-	12	120-63	436-91	2-89	166-59	2-688	.900	.900	.900	.900	.900	.900	.900	.900	.900	.900	.900

		C1 BUILDINGS			C2 BUILDINGS			C1 AND C2 BUILDING TOTAL VEHICLES															
INSTALLED TIME	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	CONST. COST (\$1000/yr)	ENERGY SAVE (MIL BTU/yr)	ECOST. SAVE (\$1000/yr)	# OF BLDG	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PATBACK (YR)	ECOST. SAVE (MIL BTU/yr)	CONST. COST (\$1000)	ECOST. COST (\$1000)	ENERGY SAVE (MIL BTU/yr)	CONST. COST (\$1000)	ECOST. COST (\$1000)	ENERGY SAVE (MIL BTU/yr)	CONST. COST (\$1000)	ECOST. COST (\$1000)	ENERGY SAVE (MIL BTU/yr)	CONST. COST (\$1000)	ECOST. COST (\$1000)	ENERGY SAVE (MIL BTU/yr)
1088	14-65	8-6	20-6	1-2	.140	-	12	31-06	46-71	8-6	64-27	3-74	-	-	-	-	-	-	-	-	-	-	-
2027	129-72	9-8	236-0	13-0	1-319	-	-	-	129-72	9-8	235-0	13-0	13-0	13-0	13-0	13-0	13-0	13-0	13-0	13-0	13-0	13-0	13-0
1010	20-10	15-0	11-8	1-2	.078	-	12	121-91	142-01	15-0	83-36	8-48	-	-	-	-	-	-	-	-	-	-	-
1020	18-74	20-0	8-8	1-2	.060	-	3	59-79	78-53	20-0	36-87	5-02	-	-	-	-	-	-	-	-	-	-	-
2006	46-61	9-8	236-0	13-0	1-319	-	16	293-66	340-27	9-8	1715-6	94-90	-	-	-	-	-	-	-	-	-	-	-
2007	76-95	9-8	235-0	13-0	1-319	-	-	-	76-95	9-8	235-0	13-0	13-0	13-0	13-0	13-0	13-0	13-0	13-0	13-0	13-0	13-0	
2045	14-95	19-0	49-7	6-5	.339	-	6	93-37	108-33	19-0	360-13	47-1	-	-	-	-	-	-	-	-	-	-	-
2050	5-85	19-0	49-7	6-5	.339	-	3	24-66	30-51	19-0	258-20	33-9	-	-	-	-	-	-	-	-	-	-	-
2063	7-38	18-0	49-7	6-5	.339	-	19	122-40	128-78	19-0	873-9	114-3	-	-	-	-	-	-	-	-	-	-	-
4290	74-35	5-0	35-6	1-2	.242	-	1	1-497	69-32	6-0	42-76	1-44	-	-	-	-	-	-	-	-	-	-	-
TOTAL	411-30	11-5	930-90	63-30	5-490	-	71	761-82	1173-13	16-1	2603-69	334-66	18-490	1-01	1-01	1-01	1-01	1-01	1-01	1-01	1-01	1-01	1-01
BUILDINGS STUDIED UNDER CONTRACT SCOPE MODIFICATION.																							

		C1 BUILDINGS			C2 BUILDINGS			C1 AND C2 BUILDING TOTAL VEHICLES															
INSTALLED TIME	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	CONST. COST (\$1000/yr)	ENERGY SAVE (MIL BTU/yr)	ECOST. SAVE (\$1000/yr)	# OF BLDG	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PATBACK (YR)	ECOST. SAVE (MIL BTU/yr)	CONST. COST (\$1000)	ECOST. COST (\$1000)	ENERGY SAVE (MIL BTU/yr)	CONST. COST (\$1000)	ECOST. COST (\$1000)	ENERGY SAVE (MIL BTU/yr)	CONST. COST (\$1000)	ECOST. COST (\$1000)	ENERGY SAVE (MIL BTU/yr)	CONST. COST (\$1000)	ECOST. COST (\$1000)	ENERGY SAVE (MIL BTU/yr)
3935	14-65	0-6	24-00	0-100	0-170	-	2	262-72	41-38	0-6	67-79	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	14-66	0-6	24-00	0-100	0-170	-	2	262-72	41-38	0-6	67-79	-	-	-	-	-	-	-	-	-	-	-	-

• BUILDINGS STUDIED UNDER CONTRACT SCOPE MODIFICATION.

• WILDLINGS STUDIED UNDER CONTRACT SCOPE MODIFICATION.

C1 & C2 BUILDING TYPES										C1 & C2 BUILDING TYPES			
INSUL. DIA. PIPES	BLDG. #	BLDG. AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVINGS (1000 BTU/YR)	CONST. COST (\$1000/YR)	ECOST. SAVINGS (\$1000/YR)	BLDG. AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVINGS (1000 BTU/YR)	CONST. COST (\$1000/YR)	ECOST. SAVINGS (\$1000/YR)	SAVE/INVEST RATIO
1E24	6.00	0.7	36.01	-200	.250		29	202.61	210.61	0.7	948.00	5.265	6.581
2E17	6.19	2.0	5.8	.080	.040		322	621.13	629.32	2.0	445.67	6.175	3.103
5E8	4.70	1.4	3.5	.035	.025		-	-	4.70	1.4	3.50	.035	.025
5E31	4.70	0.7	14.0	.070	.100		-	-	4.70	0.7	14.02	.070	.100
5E32	4.70	1.0	4.4	.030	.030		-	-	4.70	1.0	4.4	.030	.030
1E4	4.72	1.1	12.3	.095	.065		-	-	4.72	1.1	12.26	.095	.085
1E20	7.67	0.8	36.0	.200	.250		-	-	7.67	0.8	36.0	.200	.250
2E4	2.28	1.0	4.7	.031	.031		-	-	2.28	1.0	4.7	.031	.031
4E31	4.72	0.8	3.5	.020	.025		31	159.03	163.75	0.8	121.42	.694	.867
1010	20.10	1.0	9.3	.065	.065		12	121.91	142.01	1.0	65.70	.459	.459
12E3	34.73	1.1	35.9	.280	.245		-	-	34.73	1.1	35.90	.280	.245
2001	30.75	1.1	4.7	.031	.027		1	2.83	33.59	1.1	5.13	.034	.029
2007	78.85	0.08	268.6	.121	1.966		-	-	78.85	0.08	268.5	.121	1.986
2020	107.23	0.4	11.7	.035	.060		5	347.57	454.78	0.4	49.62	.148	.333
2022	37.99	0.7	8.3	.040	.060		-	-	37.99	0.7	8.32	.040	.060
2046	14.96	0.7	12.1	.060	.080		6	93.37	108.33	0.7	87.67	.435	.860
2409	7.67	.11	131.4	.100	.895		4	25.23	32.90	.11	563.63	.429	3.839
3204	12.44	.07	481.8	.155	2.337		8	32.63	45.07	.07	1745.56	.562	8.466
3238	8.63	2.07	1.5	.015	.007		3	16.42	25.05	2.07	4.35	.044	.020
4291	12.95	0.4	35.0	.105	.240		-	-	12.95	0.4	35.04	.105	.240
6137	6.56	0.9	13.1	.080	.080		63	277.60	286.17	0.8	437.95	2.674	3.008
5209	6.18	0.4	98.1	.250	.670		-	-	8.18	0.4	98.1	.250	.670
8504	8.91	1.6	28.0	.190	.123		18	44.78	53.69	1.0	168.72	1.145	.741
9660	207.62	1.5	9.3	.060	.041		2	42.68	250.21	1.5	11.21	.072	.049
TOTAL	6119.14	0.30	1288.91	2.348	7.762		524	1987.79	2336.96	0.61	6195.37	31.777	29.8

C1 BUILDINGS		C2 BUILDINGS		C1 AND C2 BUILDING TOTAL. VARIABLES	
INSUL. DTH. TRAMS	BLDG #	BLDG AREA (1000 SQ FT)	BLDG AREA (1000 SQ FT)	BLDG AREA (1000 SQ FT)	BLDG AREA (1000 SQ FT)
3A2	11.19	2.1	3.2	.052	.025
1E4	4.72	3.2	2.3	.052	.016
1E20	7.67	2.9	3.4	.052	.018
4431	4.72	7.4	1.0	.052	.007
1263	34.73	3.5	1.8	.052	.015
2001	30.75	3.9	4.7	.04	.027
2006	46.61	5.2	2.3	.04	.020
2020	107.23	1.8	4.3	.052	.029
2272	36.26	4.7	1.6	.052	.011
3238	8.63	9.7	1.1	.052	.005
4292	10.49	3.2	2.3	.052	.016
6038	13.32	3.5	2.0	.052	.015
5137	8.56	3.5	2.1	.052	.015
9503	23.05	7.4	1.0	.052	.004
9504	8.91	6.0	1.9	.052	.006
9640	261.73	6.6	1.3	.052	.006
9660	207.52	4.3	2.7	.052	.012
8665	250.91	4.3	2.7	.052	.012
TOTAL	1077.00	3.96	41.7	1.040	0.261
				206	1699.34
				2776.2	4.39
				208.45	6.287
					1.430
					4.2

C1 BUILDINGS		C2 BUILDINGS		C1 AND C2 BUILDING TOTAL. VARIABLES	
BLDG #	BLDG AREA (1000 SQ FT)	BLDG #	BLDG AREA (1000 SQ FT)	BLDG AREA (1000 SQ FT)	BLDG AREA (1000 SQ FT)
1F24	8.00	-9	21.3	.125	.145
2A17	8.19	1.0	14.0	.090	.090
6A10	4.70	.9	21.3	.125	.145
1B16	3.11	1.0	19.0	.125	.130
5B8	4.70	.9	21.3	.130	.145
5B31	4.70	.9	21.3	.125	.145
1C14	3.11	.9	19.4	.125	.132
2E4	2.28	.9	35.6	.225	.240
3E34	3.78	.9	21.0	.130	.144
4G31	20.69	1.0	51.7	.350	.360
2272	35.26	1.3	67.1	.460	.595
TOTAL	99.52	0.86	332.9	2.010	2.261
			377	986.5	1086.03
				0.94	2834.42
					17.990
					19.134
					12.7

2.5 SUMMARY OF OTHER ECO: The ECO which were not found to be applicable for further analysis are summarized as follows:

ECO NO.

7. Reduction of glass area - treated as insulated panels, ECO 4.
8. Replace kitchen light fixtures - included under ECO 12, Replace Incandescent Lighting.
10. Heating oil flow meters - do not save energy in themselves.
15. Electric radiant heat - see ECO 16
18. Economizer cycles - all air systems investigated have and are utilizing economizer cycles.
24. Reduce air flow - in air systems surveyed, excessive air flow was not encountered.
29. Chiller replacement - the only chillers encountered were those serving computer areas and are kept in good condition.
30. Replace absorption chiller - not applicable.
31. Insulate steam lines - found adequate in most buildings. DEH has active policy for steam pipe insulation.
35. Transformer over voltage - deleted from contract. Negotiated Scope P.5.
36. Transformer loading - deleted from contract. Same as ECO #35.
37. Revise or replace building HVAC controls - treated as ECO 17, Night Setback.
40. High efficiency pumps on a replacement basis - Pumps encountered were of small size (less than 5 HP) and not appropriate for change to higher efficiency.
43. Reduce street lights - deleted from contract. Scope p.5.
5. Vestibules - found applicable in eight buildings with simple paybacks ranging from 5 to 17 years. Vestibules are specific in their building application and their paybacks did not warrant extension into the general population list.

6. Loading dock seals - found to be applicable in three buildings with a range of payback of from 6 to 8-1/2 years. DEH has installed seals on nearly all of frequently used loading doors.
14. High efficiency motor replacement - motors of sufficient size and operating hours to warrant consideration occurred in four buildings with a simple payback ranging from 12 to 29 years (sufficient size is greater than 5 HP with significant hours of operation).
49. Laundry dryer heat recovery - applicable only to the main Post laundry (1401) with a simple payback of 11 years.

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3.0 TRAINING AND EXPENDABLE EQUIPMENT RECOMMENDATIONS:

3.1 TRAINING:

3.2 TRAINING COURSES AND SEMINARS:

* CORPS OF ENGINEERS - under the Government Employees Training Act the Corps of Engineers have provided a number of courses that meet unique Corps training needs. Appropriate courses are:

- ELECTRICAL INSPECTION - #042/ECE-E, NO. T1MEIN
- ENERGY CONSERVATION IN EXISTING BUILDINGS - #055/2CF-U, NO. P3MECB
- ENVIRONMENTAL ENGINEERING WORKSHOP - #102/ECE-B, NO. P1MSEC
- GENERAL CONSTRUCTION INSPECTION - #054/ECC-Q, NO. T1MGIN
- MECHANICAL INSPECTION - #074/ECE, NO. T1MMIN
- REFRIGERATION & AIR CONDITIONING INSPECTION - #096/ECE-E, NO. T1MRACIN
- WATER SUPPLY AND WATER CONSERVATION PLANNING - #041/CWP-D, NO. P1MESIAWS

AUDIOVISUAL:

- TEST AND MAINTENANCE EQUIPMENT (For further information contact Industrial Training Corp.)
- PUMP DOWN, EVACUATION, AND CHARGING (For further information contact Industrial Training Corp.)

For further information on the above C.O.E. Courses, the address is: Division Engineer

U.S. Army Engineer Division, Huntsville
Attention: HNDTD-SB, Registrar
Post Office Box 1600
Huntsville, AL 35807

Phone: (205) 895-5032

OTHER APPLICABLE NON-GOVERNMENT TRAINING INCLUDES:

- * WESCO - Courses in the latest advancements in Electromechanical and Solid State Control.
CONTACT: 2233 6th Ave. S. Seattle, WA 98134
- * CENTER FOR PROFESSIONAL ADVANCEMENTS - Short course format for Scientists, Engineers and Technical Managers. Emphasis is placed on applied and practical aspects of science and engineering. (HVAC, Feedwater Heaters, etc.)
CONTACT: P.O. Box H, East Brunswick, NJ 08816-0257
PHONE: (201) 238-1600
- * COLLEGE OF ENGINEERING, UNIVERSITY OF WISCONSIN, MADISON - Many courses offered in skill building, problem solving, technical update, career development, or whatever your continuing education needs may be. Videocassette courses are also available.
CONTACT: Department of Engineering, Professional Development, 432 North Lake St., Madison, WI 53791-9943
PHONE: 1-800-262-6243

- * ASD, INC. - Adjustable Frequency Motor Control (3 day seminar and workshop), Turbomachinery - pumps, fans and compressors (2 day seminar), Power Line Harmonics (1 day seminar and workshop).
CONTACT: 910 Sherwood Drive, Lake Bluff, IL 60044
PHONE: (312) 362-6640
- * TECHPRO - Intensive course on finding, fixing and preventing most problems.
CONTACT: 326 Hurricane Shoals Rd., Lawrenceville, GA 30245
PHONE: (404) 963-6076
- * ELECTRO TEST, INC. - Effective Electrical Preventive Maintenance and Testing.
CONTACT: 3470 Fostoria Way, P.O. Box 159, San Ramon, CA 94583
PHONE: (415) 866-8566 ext. 304
- * BIDDLE INSTRUMENT - Electrical Insulation Testing.
- * MULTI-AMP INSTITUTE - Protective Devices Maintenance.
- * INSTRUMENT SOCIETY OF AMERICA - Boiler Control for Energy Efficiency.
- * AIChE - Pump Technology.
- * MARSHALL MAINTENANCE - Centrifugal Pump Maintenance.
- * GMI ENGINEERING AND MANAGEMENT INSTITUTE - Industrial Energy Management.
- * INTERNATIONAL PROGRAMMABLE CONTROLLERS, INC. - Introduction to Programmable Controllers.
- * TEL-A-TRAIN, INC. - Programmable Controller Training Package.
- * GREEN RIVER COMMUNITY COLLEGE - Basic Hydraulics, Water/Wastewater Training, Lubricants, etc.
CONTACT: 12401 S.E. 320th St., Auburn, WA 98002
PHONE: (206) 833-9111
- * LOCTITE CORPORATION - Maintenance and Repair Seminar.
CONTACT: 705 North Mountain Rd., Newington, CT 06111
- * NATIONAL TECHNOLOGY TRANSFER, INC. - Hydraulic Systems.
CONTACT: P.O. Box 110397, Aurora, CO 80011
PHONE: (303) 360-0101
- * TACOMA COMMUNITY COLLEGE - Energy Management.
CONTACT: 5900 So. 12th St., Tacoma, WA 98465
PHONE: (206) 756-5000
- * HONEYWELL - Winter Changeover Training Workshop
 - Pneumatic Temperature Control
 - Burner/Boiler Start UpCONTACT: Building Services Division, Honeywell Plaza, Minneapolis, MN 55408
PHONE: (612) 870-5200

- * GEORGE WASHINGTON UNIVERSITY - Electrical Equipment Testing and Maintenance.
CONTACT: School of Engineering & Applied Science, Washington, D.C. 20052 PHONE: (202) 676-6106
TOLL FREE: 1-800-424-9773 (in the USA)
- * UNIVERSITY OF WASHINGTON, COLLEGE OF ENGINEERING - Engineering Management Courses, Project Cost Control.
CONTACT: 353 Loew Hall, FH-18, Seattle, WA 98195
PHONE: (206) 543-5539
- * NORTH SEATTLE COMMUNITY COLLEGE - Heating, Air Conditioning and Refrigeration Technology.
- * AEE ENERGY SEMINARS - Energy Auditing for Buildings and Industry - Waste Heat Recovery
CONTACT: 4025 Pleasantdale Rd., Suite 340, Atlanta, GA 30340
PHONE: (404) 447-6452
- * PACIFIC LUTHERAN UNIVERSITY - Professional Development Guide 1985
CONTACT: Tacoma, WA 98447 PHONE: (206) 535-7330

3.3 AUDIOVISUAL TRAINING:

- * DUPONT - Videotapes and self-study courses in various fields.
(Some examples: Forklift Truck Operator Training, Pipe-Fitting, Basic Rigging, Safety Training Programs, etc.)
CONTACT: Training Services, Barley Mill 19-1210, Wilmington, DE 19898 PHONE: (302) 992-3620
- * NUSTC - Power Principles Programs (Basics & Practice)
- Chemical Plant Operations Training Program
- Boiler Training
CONTACT: 910 Clopper Rd., Gaithersburg, MD 20878-1399
PHONE: 1-800-848-1717
- * NATIONAL EDUCATION TRAINING CORPORATION - Electrical Technology, Hydraulics, etc.
- * INDUSTRIAL TRAINING CORPORATION - Air Conditioning and Refrigeration Training Program.

3.4 REFERENCE MATERIALS:

- * PLANT ENGINEERING - Reference file reprints on controllers, software, electrical controls, flowmeters, etc.
- * AEE ENERGY BOOKS - Reference catalog to help improve Operational and Energy Efficiency. (Waste Heat Recovery, Photovoltaic Applications, Energy Analysis, Nomograms for Steam Generation, Boiler Operations Sourbooy, etc. Cogeneration and Energy Management videotape courses are also available).
CONTACT: 4025 Pleasantdale Rd., Suite 340, Atlanta, GA 30340

* PLANT ENGINEERING - Nine (9) volumes of a Plant Engineer's Proven Problem Solvers (Electrical, Fluid Power and Mechanical Power Transmission, Material Handling, Construction, Maintenance, Pollution Control, Plant Protection and Energy Management).

CONTACT: Reprint Department, 1301 So. Grove Ave., P.O. Box 1030, Barrington, IL 60010

* APPA - Resources in Facilities Management.

CONTACT: 1446 Duke St., Alexandria, VA 22314-3492

* L.H. BATES VOCATIONAL - TECHNICAL INSTITUTE - Catalog of classes 1983/1984/1985

CONTACT: 1101 So. Yakima, Tacoma, WA 98405

PHONE: (206) 597-7220

* FORT STEILACOOM COMMUNITY COLLEGE - Catalog 1984 - 1985

CONTACT: 9401 Farwest Drive SW, Tacoma, WA 98498-1999

PHONE: (206) 964-6500

3.5 EXPENDABLE EQUIPMENT: The following list of energy consuming or related repair/replacement parts with a potential life expectancy of 5 years or less (see negotiated Scope of Work for criteria) was observed at Fort Lewis during the building surveys. These parts could be replaced with more energy efficient equipment as a normal maintenance procedure.

1. Thermostats
2. Aquastats
3. Oil Burner Nozzles
4. Fan Belts
5. Fan and Motor Sheaves
6. Fluorescent Light Ballasts
7. Incandescent Light Bulbs
8. Fluorescent Light Bulbs
9. Steam Traps

ENERGY SAVING PRODUCT & INSTALLATION SPECIFICATIONS

1. Thermostats (room): Adjustable electronic over a 60 - 80 degree range (+/- 1 degree F) Mercury or Bimetallic Thermometer; Tamper proof screws; Removable adjustment nob, locking cover. Comply with Federal and Military Standards and Specification 15805-13.5.2 and 15805-13.5.3.
Manufacturers: Johnson Controls, Barber Coleman, Powers
2. Aquastats: Electronic immersion type with averaging bulb; snap action electric switch; manual surface setpoint adjustment.
Manufacturers: Johnson Controls, Powers, Honeywell
3. Oil Burner Nozzles: High efficiency turbulator type nozzle; circular spray pattern; integral filter/strainer. Comply with Corps of Engineers Guide Specification 15602.2-9.1.
Manufacturers: Monarch, Cleaver Brooks, Kiwanee

4. Fan Belts: Notched V-Belt type, match pitch of sheaves provided; belt shall not slip under full load start conditions; belt shall ride with at least 7/8" of belt radius below the wall of the sheave.
Manufacturers: Gates, Browning, Dayton
5. Fan and Motor Sheaves: Preventive Maintenance sheave replacements; remove adjustable sheaves and replace with fixed sheave. Provide the number of grooves as recommended by fan Manufacturer or as required to keep belts from slipping under full load start conditions.
Manufacturer: Gates, Browning, Dayton
- 6 & 7. Fluorescent light ballasts and bulbs: Comply with ANSI C82.1 and UL 935; UL and Certified Ballast Manufacturers (CBM) approved; for service without the use of starters. Ballasts shall be high power factor type and shall produce full light output with 430 milliampere circuits and 40 watt lamps. All ballasts shall be energy saving design that does not use more than 74 watts for bare lamp fixtures and 74 watts in enclosed fixtures for two standard 34 watt rapid start lamps with 277 volt ballasts, and 83 watts and 75 watts with 120 volt ballasts. Ballasts shall not contain any PCB. Comply with Federal Specification W-B-30A & AM-2, W-L-00116D.
Manufacturers: General Electric, Westinghouse, Jefferson, Universal or Advance mfr; rapid start circuit.
8. Incandescent Light Bulbs: Inside frosted, dual service 125 - 130 volt, krypton type or energy saving equivalent. Comply with Federal Specification W-L-101H.
Manufacturers: General Electric, Sylvania, Phillips, Westinghouse
9. Steam Traps: Energy saving float type with integral thermostatic air bypass. Provide traps for use at pressure of steam system being modified. Comply with Federal Specification W-W-T-696 for type, style and class as applicable.
Manufacturers: Sarco, Armstrong, Reliance